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Original Research

To compare isotonic vs hypotonic fluid maintenance in children- A clinical study

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***ABSTRACT*:**
Background: Use of conventional volume maintenance isotonic saline has been shown to reduce the incidence of hyponatraemia. The present study was conducted to compare isotonic vs hypotonic fluid maintenance in children. **Materials & Methods:** The present study was conducted on 40 children age ranged 1- 6 years of both genders. Patients were divided into 2 groups. Group I received isotonic saline solution (0.9% NaCl in 5% dextrose) and group II received hypotonic saline solution (0.18% NaCl solution in 5% dextrose). Maintenance fluid volume for administration was calculated using Holliday and Segar formula. **Results:** The mean serum sodium in group I was 135.2 mEq/L and in group II was 136.7 mEq/L serum osmolality was 290.4 mOSm/L in group I and 294.2 mOSm/L in group II, serum potassium was 3.4 mEq/L in group I and 4.0 mEq/L in group II, serum chloride was 98.1 mEq/L in group I and 100.4 mEq/L in group II, blood urea was 38.4 mg/dl in group I and 39.1 mg/dl in group II, serum creatinine was 0.81 mg/dl in group I and 0.73 mg/dl in group II, blood sugar was 105.6 mg/dl in group I and 97.2 mg/dl in group II. The difference was non- significant (P>0.05). **Conclusion:** Authors found isotonic fluid results in fewer episodes of hyponatremia than hypotonic fluid in children during the first hours of intravenous fluid therapy.
Key words: Hyponatremia, Hypotonic, Isotonic

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INTRODUCTION

Recommendation for the use of a hypotonic saline solution (0.18% saline in 5% dextrose) in children is still a debated subject despite half a century of its practice.[1] Reports of symptomatic hyponatremia in hospitalized surgical and non-surgical pediatric patients – caused primarily by various non-osmotic release of vasopressin, but contributed by electrolyte-free water input in a proportion of cases – have fueled these debates. Use of conventional volume maintenance isotonic saline has been shown to reduce the incidence of hyponatraemia. Using indirect calorimetric measurements, energy expenditure in critically ill children may be as low as 50- 60 kcal/kg/day.[2]

Acute hyponatremia is defined as a rapid fall in serum sodium from a normal level to < 135 mmol/L within 48 hours.[3] This can result in acute cerebral edema and brain stem herniation; and has been associated with the administration of intravenous (IV) hypotonic fluids in children, particularly in the perioperative period. These patients may retain free water due to non-physiological secretion of anti-diuretic hormone (ADH) stimulated by for example, pain, vomiting, anxiety, narcotics, anesthetic agents and positive pressure ventilation. The use of isotonic fluids, which contain no electrolyte free water, will reduce this risk but not eliminate it.[4]

Any hospitalized child requiring IV maintenance fluids should be considered at risk of non-physiological (inappropriate) ADH secretion. Groups particularly at risk identified in published studies include children undergoing surgery, in ICU and those with acute illnesses including meningitis, encephalitis, bronchiolitis and pneumonia.[5] The present study was conducted to compare isotonic vs hypotonic fluid maintenance in children.

MATERIALS & METHODS

The present study was conducted in the Pediatrics department. It comprised of 40 children age ranged 1- 12 years of both genders. The study was approved from ethical committee. Parents were informed regarding the study and written consent was obtained.

Data such as name, age, gender etc. was recorded. Patients were divided into 2 groups. Group I received isotonic saline solution (0.9% NaCl in 5% dextrose) and group II received hypotonic saline solution (0.18% NaCl solution in 5% dextrose). Maintenance fluid volume for administration was calculated using Holliday and Segar formula. All patients were monitored clinically for symptoms and signs of dysnatremia, and signs of fluid overload or dehydration throughout the study period. Results were subjected to statistical analysis. P value less than 0.05 was considered significant.

RESULTS

Table I Distribution of patients

Groups	Group I	Group II
Solution	Isotonic saline solution	Hypotonic saline solution
Number	20	20

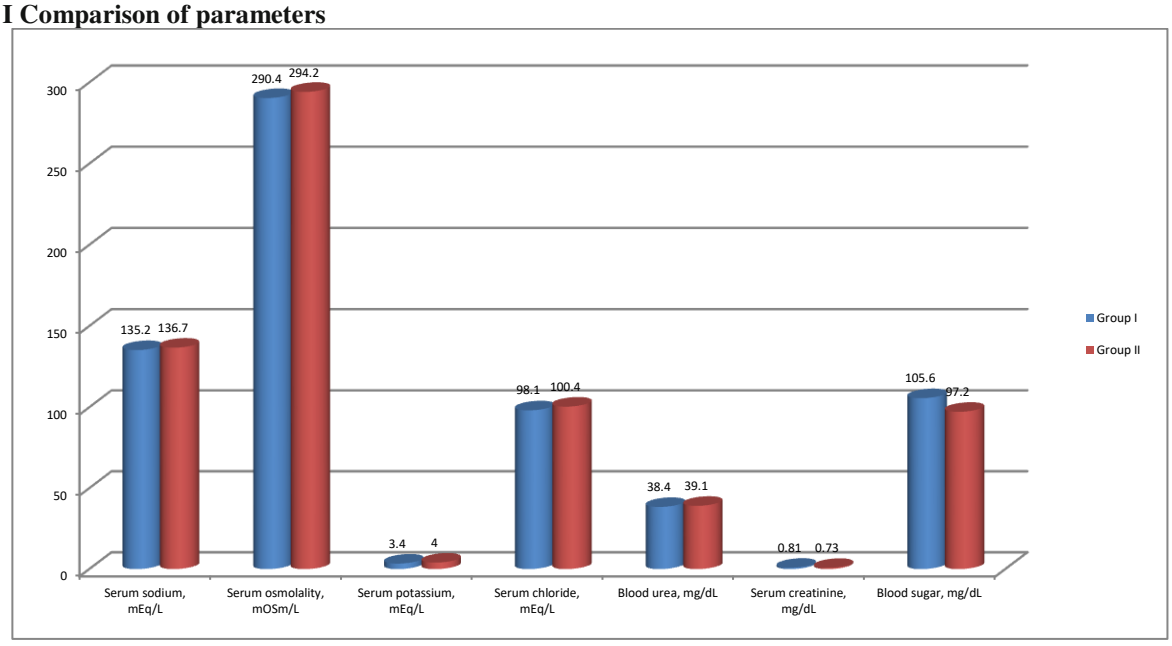
Table I shows that patients were divided into 2 groups. Group I received isotonic saline solution (0.9% NaCl in 5% dextrose) and group II received hypotonic saline solution (0.18% NaCl solution in 5% dextrose).

Table II Comparison of parameters

Parameters	Group I	Group II	P value
Serum sodium, mEq/L	135.2	136.7	0.1
Serum osmolality, mOSm/L	290.4	294.2	0.3
Serum potassium, mEq/L	3.4	4.0	0.4
Serum chloride, mEq/L	98.1	100.4	0.1
Blood urea, mg/dL	38.4	39.1	0.9
Serum creatinine, mg/dL	0.81	0.73	0.6
Blood sugar, mg/dL	105.6	97.2	0.08

Table II, graph I shows that mean serum sodium in group I was 135.2 mEq/L and in group II was 136.7 mEq/L serum osmolality was 290.4 mOSm/L in group I and 294.2 mOSm/L in group II, serum potassium was 3.4 mEq/L in group I and 4.0 mEq/L in group II, serum chloride was 98.1 mEq/L in group I and 100.4 mEq/L in group II, blood urea was 38.4 mg/dl in group I and 39.1 mg/dl in group II, serum creatinine was 0.81 mg/dl in group I and 0.73 mg/dl in group II, blood sugar was 105.6 mg/dl in group I and 97.2 mg/dl in group II. The difference was non- significant (P>0.05).

Graph I Comparison of parameters



DISCUSSION

The appropriate composition and quantity of IVFs needed to preserve a child's extracellular volume while simultaneously minimizing the risk of developing volume depletion, fluid overload, or electrolyte disturbances, such as hyponatremia or hypernatremia.[6] While most children will tolerate standard maintenance fluid requirements, some acutely ill children with increased ADH secretion may benefit from their maintenance fluids being restricted to two-thirds of the normal recommended volume. Some examples may include those groups mentioned above. Normal maintenance requirements should be in the form of isotonic saline.[7]

Tonicity represents the concentration of effective osmoles (Na+, K+, Ca++, Mg++) which are impermeable across the cell membrane and can affect the transcellular movement of water. Urea and dextrose are ineffective osmoles as urea is permeable across the cell membrane and dextrose is metabolized. Isotonic fluids have a total electrolyte composition similar to the aqueous phase of plasma (154 mEq/L). Hypotonic fluids have a total electrolyte composition < the aqueous phase of plasma.[8] The present study was conducted to compare isotonic vs hypotonic fluid maintenance in children.

In present study, patients were divided into 2 groups. Group I received isotonic saline solution (0.9% NaCl in 5% dextrose) and group II received hypotonic saline solution (0.18% NaCl solution in 5% dextrose).

Shamim et al[9] conducted a study on 60 children to receive intravenous fluid for the next 48 hours. Hypotonic fluid (Standard maintenance volume as 0.18% NaCl in 5% dextrose) or Isotonic fluid (60% Standard maintenance volume as 0.9% NaCl solution in 5% dextrose) was given. Incidence of hyponatremia and serum sodium, serum osmolality, blood sugar, blood urea, serum creatinine, serum potassium, serum chloride, pH, urine output, change in weight, morbidity and death was recorded. At 24 hours, hyponatremia was noted in 7 (24%) patients in the isotonic and 16 (55%) in hypotonic group (P=0.031). At 48 hours, hyponatremia was noted in 4 (14%) and 13 (45%) patients in isotonic and hypotonic group, respectively (P=0.02). There was significant change in sodium levels in both isotonic (P=0.036) and hypotonic.

We found that mean serum sodium in group I was 135.2 mEq/L and in group II was 136.7 mEq/L serum osmolality was 290.4 mOSm/L in group I and 294.2 mOSm/L in group II, serum potassium was 3.4 mEq/L in group I and 4.0 mEq/L in group II, serum chloride was 98.1 mEq/L in group I and 100.4 mEq/L in group II, blood urea was 38.4 mg/dl in group I and 39.1 mg/dl in group II, serum creatinine was 0.81 mg/dl in group I and 0.73 mg/dl in group II, blood sugar was 105.6 mg/dl in group I and 97.2 mg/dl in group II.

Oral fluid intake must be included in the estimation of total fluid intake. Most oral fluids are very hypotonic i.e. much below the sodium concentration of recommended IV fluids. Both the volume and the concentration of sodium in IV and oral fluids are important contributors to the development of hyponatremia. Proprietary enteral fluid preparations and some standard parenteral nutrition (PN) solutions are low in sodium (60mmol/L) are available to order as required. PN orders may also customized, with varying sodium amounts based on the clinical needs of the patient.[10]

CONCLUSION

Authors found isotonic fluid results in fewer episodes of hyponatremia than hypotonic fluid in children during the first hours of intravenous fluid therapy.

REFERENCES

1. Arieff AI, Ayus JC, Fraser CL, Hyponatraemia and death or permanent brain damage in healthy children. BMJ. 1992;304:1218-22.
2. Halberthal M, Halperin ML, Bohn D. Acute hyponatremia in children admitted in hospital. BMJ. 2001;322:780-2. 5. Holliday MA, Friedman A, Segar ME, Chesney R, Finberg L. Acute hospital induced hyponatremia in children: A physiological approach. J Pediatr. 2004;145:584-7.
3. Montañana PA, Modesto i Alapont V, Ocón AP, López PO, López Prats JL, et al. The use of isotonic fluid as maintenance therapy prevents iatrogenic hyponatremia in pediatrics: A randomized, controlled open study. Pediatr Crit Care Med. 2008;9:658-9.
4. Briassoulis G, Venkataraman S, Thompson AE. Energy expenditure in critically ill children. Pediatr Crit Care Med. 2000;28:1166-72.
5. Choong K, Bohn D. Maintenance parenteral fluids in the critically ill child. J Pediatr (Rio J). 2007; 83:S3-10.
6. Duke T, Mokela D, Frank D, Michael A, Paulo T, Mgone J, et al. Management of meningitis in children with oral fluid restriction or intravenous fluid at maintenance volumes: a randomized trial. Ann Trop Pediatr. 2002;22:145-57.
7. Hoorn EJ, Geary D, Robb M, Halperin ML, Bohn D. Acute hyponatremia related to intravenous fluid administration in hospitalized children: An observational study. Pediatrics. 2004;113:1279-84.
8. Brazel P, McPhee IP. Inappropriate secretion of antidiuretic hormone in postoperative scoliosis patients: The role of fluid management. Spine. 1996;21:727.
9. Shamim A, Afzal K, Ali SM. Safety and efficacy of isotonic (0.9%) vs. hypotonic (0.18%) saline as maintenance intravenous fluids in children: a randomized controlled trial. Indian pediatrics. 2012;51(12):969-74.
10. Neville K, Verge C, Rosenberg A, O'Meara M, Walker J. Isotonic is better than hypotonic saline for intravenous rehydration of children with gastroenteritis: A prospective randomized study. Arch Dis Child. 2006;91:226-32.